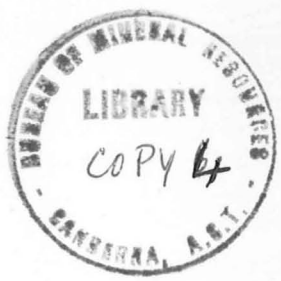
COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1971/88

Notes to Accompany International Geological Map of the World Scale 1:15,000,000



by

R. G. Warren and H. F. Doutch

RECORD NO. 1971/88

NOTES TO ACCOMPANY INTERNATIONAL GEOLOGICAL MAP OF THE WORLD

SCALE 1:15,000,000

By

R.G. Warren & H.F. Doutch

NOTES TO ACCOMPANY INTERNATIONAL GEOLOGICAL MAP OF THE WORLD SCALE 1:15,000,000*

The Australian continent appears to have evolved since stabilization of the first craton in Archaean times by the repeated welding of deformed platformal and geosynclinal deposits onto a pre-existing craton coupled with the accumulation on each stabilized craton of widespread relatively little deformed sedimentary rocks.

Archaean

Archaean rocks crop out in the west of the continent. The oldest, dated at about 3000 m.y., occur east of Port Hedland in the Pilbara Block and in the Darling Range immediately east of Perth in the Yilgarn Block (Fig.1). Of the three main types of Archaean rocks in these two areas the most common are acid gneisses and granites; these intrude geosynclinal sequences of basic and ultrabasic lavas and intrusives. Least common are acid lavas and sedimentary rocks, including jaspilites. In northern Australia small areas of gneiss and granite of late Archaean age are exposed in the cores of anti-formal structures. Some Precambrian rocks in northern Australia may be of Archaean age.

Lower Proterozoic

About 2200 m.y. ago basic lavas were poured out in a region south-east of Port Hedland as the beginning of a platformal sequence which continued with some chemical sediments, including the banded iron ores of the Hamersley Ranges, deposited under very stable conditions. At the same time thicker deposits were laid down in northern Australia, partly on continental basement but with many geosynclinal characteristics, as in the Pine Creek Geosyncline; these were deformed about 1900 m.y. ago. The rocks of the Eyre Peninsula, part of the Gawler Block, and the region near Broken Hill also appear to have been deposited in the early Proterozoic, although their deformational histories belong within Carpentarian times. Precambrian rocks east of Broken Hill are probably of the same age as those at Broken Hill.

Carpentarian

Carpentarian time (Middle Proterozoic, starting about 1800 m.y. ago) began in northern Australia with widespread acid volcanism and granite intrusions in the areas where rocks were folded at the end of the Lower Proterozoic. This was followed by basic volcanics, beginning platformal sedimentation across the north of the continent from the Kimberley area in the west to the Mount Isa geosynclinal zone in the east. In the geosyncline a thicker sequence developed and was folded about 1650 m.y. ago, with accompanying granite intrusions.

In the south of the continent folding within the Gawler Block was followed by acid volcanism. Granites intruded these rocks, and also others near Broken Hill.

Thick sequences of geosynclinal type accumulated in the Musgrave Block of central Australia, but were not deformed until earliest Adelaidean time.

In Western Australia the Gascoyne area was deformed. This deformation also affected much older rocks, as did a similar event in the Albany-Fraser Ranges area; granites were intruded in both areas during these times.

*Being prepared by the Commission for the Geological Map of the World from a compilation at 1:6,000,000 scale by B.K. Grahame.

The Arunta Block of Central Australia may have formed mainly during Carpentarian time, although it incorporates some older rocks; syntectonic and post-tectonic granites and some metamorphic rocks give isotopic ages within this time range.

Adelaidean

Adelaidean (late Proterozoic) time started about 1400 m.y. ago and ended with the advent of the Cambrian. The western two-thirds of the present continent was mostly stable during this period. Only three small regions were metamorphosed, two in the extreme west of the continent, and the other in Tasmania. The Musgrave Block reached stability very early in Adelaidean time; later, acid volcanism and acid and basic intrusions occurred between 1050 and 1000 m.y. ago. The northern margin of the block was somewhat deformed about 600 m.y. ago.

Adelaidean platform sediments occur east of Geraldton in Western Australia and in a series of once interconnected basins stretching from west of Mount Isa to the southern margin of the continent at Adelaide, and include the 'Adelaide Geosyncline' (platformal sedimentation persisted in most of these areas with only minor interruptions until the middle Palaeozoic). Another basin developed on the northern edge of the continent in Arnhem Land.

The age of initiation of the Georgetown Inlier in northeastern Australia is unknown, but is reached final stability in the early Adelaidean. Glaciation, comparable to that of the Lower Palaeozoic and Pleistocene, is recorded in the presence of tillites and glacial pavements in South Australia and northwestwards to the Kimberley Basin.

Cambrian

The Cambrian Period began without a great change in the distribution of sedimentation (and indeed without unconformity in many places) throughout the central and southern parts of the continent. Basic volcanics flooded across much of northern Australia, followed by a period of stability during which mainly carbonates were deposited. In the south a geosynclinal trough developed east of Adelaide and Broken Hill and in Tasmania ultrabasic rocks were emplaced after basic volcanism and geosynclinal sedimentation. Some metamorphic rocks east of Broken Hill and others west of Townsville and on the coast south of Sydney may be of Cambrian age.

Ordovician

Platformal sedimentation began in the west and northwest in the Ordovician and continued in northern and central Australia. However, the platform and geosynclinal deposits near Adelaide and Broken Hill were folded and geosynclinal sedimentation shifted eastward; a large area of Victoria and central New South Wales is composed of rocks laid down in the Lachlan Geosyncline during the Ordovician and deformed before the Silurian. A zone in central and northern Queensland likewise is Ordovician in both sedimentary and metamorphic age and Ordovician granites are present.

Silurian

The Silurian saw a contraction in the area of platformal sedimentation; sediments possibly of this age occur in the west, and centre of Australia. In nearly all the geosynclinal belts of eastern Australia, including the Lachlan Geosyncline, Hodgkinson Basin, Yarrol Trough, and New England Geosyncline, Silurian sedimentation was confined mainly to narrow troughs. Toward the close of the period acid volcanism, granite intrusion, and

deformation were widespread in Victoria and central New South Wales in the Lachlan Geosyncline and constituted a major orogeny.

Devonian

The pattern of the geological history of Australia changed markedly in mid-Devonian time.

During the early Devonian the pattern of deposition was a modification of that of the Silurian. Platformal sedimentation occurred in central Australia and along the west coast of the continent. Marine sediments were laid down in troughs and basins within the active geosynclinal belts of eastern Australia and before late Devonian time deformation and igneous intrusion were widespread there.

From the mid-Devonian onwards orogenic activity gradually died out in the Lachlan Geosyncline. Geosynclinal deposition continued to the east in the New England-Yarrol belt. Acid volcanism broke out in parts of the previously active Lachlan Geosyncline, but most of the sediments were molasse-like fluvatile and lacustrine deposits. Eastward in the active zone flysch-like sediments were laid down, partly on older continental basement. In central Australia major upheaval was followed by molasse-like sedimentation which persisted into the early Carboniferous. In the west the late Devonian to early Carboniferous Fitzroy Trough developed, with a fringe of reef limestone.

In northern Queensland sedimentation in the Hodgkinson Basin apparently persisted through the Devonian without any marked disruption.

Carboniferous

In northeastern Australia, in the Hodgkinson Basin, geosynclinal deposition ceased early in the Carboniferous and the area was folded and partly metamorphosed. Acid volcanism, mainly in ring complexes with granites, followed the folding; igneous activity spread beyond the limits of the basin north as far as Cape York, west into the Precambrian craton, and south into central Queensland.

Geosynclinal deposition farther south in the active eastern zone continued in some areas into the Permian, but elsewhere was terminated by folding late in the Carboniferous.

In New South Wales and Victoria in the Lachlan Geosyncline, granites, volcanics, and sediments of early Carboniferous age are commonly associated with the development of ring structures.

Platform deposits are confined to small areas in troughs in northwestern and central Australia, where deformation ended sedimentation over a wide area towards the end of the early Carboniferous.

Permian

In northeastern Australia acid volcanism and granite intrusion persisted into the Permian, followed by phases of granite intrusion related to orogenesis farther south, where granites of Permian age were intruded in parts of the active zone.

Along Australia's active eastern margin geosynclinal sedimentation continued with volcanic debris and trubidites until terminated by a major orogeny; some sediments were folded late in the Permian and some early in the Triassic.

Along the margin between the active zone and the new craton formed from the older geosynclinal zones to the west, granite and serpentinite were emplaced and uplift ensued, accompanied by the downwarping of the craton edge to form a linear trough, the Bowen and Sydney Basins, in which sediments, including coal, and andesitic volcanics were deposited.

This trough was connected with platformal basins formed on the craton to the west; these and other Permo-Triassic basins in eastern Australia are mostly concealed beneath younger cover. In the west of the continent Permian sediments are found in platformal basins west of the Pilbara Block, in the Fitzroy Trough area, and in offshore areas to the northwest.

The Permian was partly a period of glaciation, and thin spreads of glacigene deposits occur in many places on the continent as sheets, glacial valley fill, and glacial outwash fans. Coal bearing strata are preserved in a small ice-eroded basin east of Perth.

Triassic

In eastern Australia the eruption of acid and andesitic volcanics followed the major orogenesis. Granite was emplaced along the previously active eastern zone during the early Triassic. The succeeding non-marine sedimentation was probably mainly deltaic. In eastern Australia basic sedimentation continued from the Permian through the rest of the Triassic without major interruption.

Thick platformal, partly marine sedimentation occurred on the western margin of the continent; thin non-marine sediments were deposited in isolated basins farther inland.

From this time onwards the whole of Australia behaved as a single craton, more unstable peripherally than internally.

Jurassic

Early in the Jurassic and great sheet of dolerite was emplaced in Tasmania; smaller bodies are found in New South Wales. Lampriote plugs which occur in the Fitzroy Trough in the northwest of Australia are thought to be Jurassic.

River systems deposited fluviatile and deltaic arenaceous and argillaceous platformal sediments to cover Permo-Triassic basins in the east of the continent and in new pericontinental depressions. Marine Jurassic rocks are found in the northwest and south of the continent.

Cretaceous

Platformal sedimentation continued without major changes from the Jurassic. During the early Cretaceous the sea transgressed much of inland eastern Australia, spreading a veneer of sediments which concealed more of the Permo-Triassic platformal basins. The periphery of the continent was unstable to various degrees; thickest Jurassic and/or Cretaceous platformal sedimentation occurred in offshore parts of the Laura and Maryborough Basins off the east coast, the Gippsland, Otway, and Eucla Basins off the south coast, and the Perth Basin and continental shelf areas farther north off the west coast.

In the northeast acid volcanics accompanied intrusion of granites. Much of the outcrop is found on offshore islands.

Tertiary

The early Tertiary was a period of stability, with erosion and deep weathering throughout much of the continent. Marine sedimentation was in pericontinental platformal basins representing a continuation of Mesozoic conditions. Eocene limestone occurs in the southwest and Miocene limestone in the south; the Great Barrier Reef started growing. Continental Tertiary sediments are confined to small basins, narrow troughs, old river courses, and thin veneers.

Basic lavas were erupted over a near-coastal strip of eastern Australia partly during the Oligocene, and, more extensively, from late Miocene to Recent times. Varying uplift of the eastern continental margin occurred in the late Tertiary; mild post-Mesozoic epeirogenic tectonics affected much of the rest of Australia.

Quaternary

The Pleistocene ice age caused glaciation only in Tasmania and the highest peaks of scutheastern Australia. The main effect was fluctuations from arid to semi-arid climatic conditions in the inland of Australia. During the driest periods sand dunes and sand sheets spread across most of the inland; these are now mostly stabilized by vegetation. Widespread spasmodic alluviation provided some of the sand, and also finer material for loess-like deposits in southeastern Australia. Large dunes also built up along parts of the east coast and on Eyre Peninsula.

Small deltaic systems are building out from some river mouths; complex delta-like giant fan deposits make up much of the western half of Cape York Peninsula. The major Quaternary depositional feature is the Great Barrier Reef, consisting of reef and detrital limestones and some admixed terrestrial detritus.

FIGURE 1.

PINE CREEK GEOSYNCLINE
BONAPARTE GULF BASIN
Arnhem Land
McARTHUR BASIN
DALY RIVER BASIN
VICTORIA RIVER BASIN
KIMBERLEY BASIN
HALLS CREEK BELT
FITZROY TROUGH
ORD BASIN
WISO BASIN
GRANITES-TANAMI BLOCK
GEORGINA BASIN
Port Hedland
PILBARA BLOCK
CANNING BASIN
ARUNTA BLOCK
NGALIA BASIN
MT ISA BLOCK
Mt Isa
GASCOYNE BLOCK
HAMERSLEY BASIN
AMADEUS BASIN
BANGEMALL BASIN
CARNARVON BASIN
MUSGRAVE BLOCK
PEDIRKA BASIN
OFFICER BASIN
ARCKARINGA BASIN
NORTHAMPTON BLOCK
Geraldton
YILGARN BLOCK
EUCLA BASIN
PERTH BASIN
Perth
NATURALISTE BLOCK
ALBANY-FRASER BLOCK
GAWLER BLOCK
Eyre Peninsula
Adelaide
KANMANTOO TROUGH
ADELAIDE GEOSYNCLINE
WILLYAMA BLOCK
DARLING BASIN
Broken Hill
MURRAY BASIN
OTWAY BASIN
BASS BASIN
GIPPSLAND BASIN
TYENNA-ROCKY CAPE BLOCK
TASMANIA BASIN
Cape York
CARPENTARIA BASIN
LAURA BASIN
HODGKINSON BASIN
GEORGETOWN INLIER
BROKEN RIVER EMBAYMENT
Townsville
DRUMMOND BASIN
ANAKIE HIGH
GALILEE BASIN
BOWEN BASIN
EROMANGA BASIN
ADAVALE BASIN
COOPER BASIN
SURAT BASIN
YARROL TROUGH
MARYBOROUGH BASIN
ESK RIFT
CLARENCE-MORETON BASIN
NEW ENGLAND GEOSYNCLINE
LACHLAN GEOSYNCLINE
SYDNEY BASIN
Sydney

AUSTRALIAN TECTONIC DOMAINS

0 100 200 300 400 500 Km
0 100 200 300 Miles

Geosyncline, and metamorphic and igneous complexes

Young

Overlapping Sedimentary Basin (broken pattern indicates Basin is concealed)

Old

To accompany Record 1971/88

Aus 2/177